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Modelling of cycles in the residential real estate market  
– interactions between the primary and the secondary  
market and multiplier effects

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Hanna Augustyniak, Jacek Łaszek, Krzysztof Olszewski, Joanna Waszczuk

Hanna Augustyniak – Economic Institute, National Bank of Poland.

Jacek Łaszek – Economic Institute, National Bank of Poland and Warsaw School of Economics.

Krzysztof Olszewski – Economic Institute, National Bank of Poland. Corresponding author.

E-mail: Krzysztof.Olszewski@nbp.pl

Joanna Waszczuk – Economic Institute, National Bank of Poland.

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***Abstract***

*While analysing the housing market, we focus on the short-term modelling of the housing units market instead of analysing the long-term housing space market. In this context, even a minor change in factors affecting the real estate market leads, due to the multiplier effect, to strong shocks on the demand side, and, consequently, to an excessive reaction of the supply side. These shocks, depending on the price elasticity of supply and demand, may disappear or explode. This article presents the modelling of cycles in the residential real estate market. We focus on price changes and the number of housing units in the primary and secondary market. We find that in order to smooth the housing cycle, the housing demand needs to be smoothed. This can be achieved with the use of fiscal policy, prudential regulations and housing policy.*

**Key words:** Housing market cycles; disequilibrium; banking sector; regulation;

**JEL Classification Numbers:** E32, E44, E37, R21, R31;

## 1. Introduction

The residential real estate market, similarly to other markets, shows cyclical variations in prices and the number of constructed housing units. These changes are not random but driven by specific factors. One of those factors, which distinguishes the housing market from other markets, is its different behaviour in the short run and long run. In the long run, demand is determined by fundamental factors and the supply side adjusts to the demand side. Supply adjustments take a long time and result from new construction or the depreciation of the housing stock. Demand shocks generate accelerator effects, because the current supply is only marginal as compared to the housing stock, while the demand shock concerns nearly the whole housing stock. Additionally, the financial system and consumer behaviour, including speculative behaviour, have a pro-cyclical effect. As supply substantially lags the price impulse and the supply elasticity generally exceeds the demand elasticity, there are short-term tendencies to generate lasting cycles. If additionally some factors accumulate, the cycles may turn into a real estate crisis.

Real estate market models are well described in the literature. One well known is the DiPasquale and Wheaton (1992) model, yet it focuses on the housing market in the long run. Cycles in the real estate market and their occurrence are described by, among others, Wheaton (1999), whereas the supply side is analysed by DiPasquale (1999). Further on, Hott and Jokipii (2012) show that housing market bubbles are largely affected by the persistence of low interest rates. We present the related literature whenever it is appropriate in the remainder of the text.

Housing as a capital good generates housing services, which can directly meet the owner's needs, be the object of commercial activity or speculation. As a tangible fixed asset housing is subject to speculations based on expectations about its price growth in the future. According to Case and Shiller (2003), during the last boom buyers in the US cherished too optimistic and unrealistic expectations about a further price growth. Yet, in historical terms, housing is also a consumer good which satisfies the owner's housing needs, provides housing security and additionally, ensures a relatively safe, long-term investment of savings. Thus, housing is not only the housing space but also an object, which is determined by the stream of utility

that it generates. Housing space is one of its main features priced in the market and affecting the value of housing. It should also be added that housing is a heterogeneous good, not only from the point of view of the abovementioned functions it serves, but also in terms of its features, which are often differently evaluated in each of the analysed functions. Therefore, we adopt Rosen's (1974) approach, defining housing as a heterogeneous good, whose value is determined by the sum of the assessment of its features.

Already King (1976), basing on Lancaster's (1966) theory on heterogeneous goods, concluded that housing may be considered as a basket of goods generating a stream of services. In the case of housing, this stream depends mainly on its quality and location, which affects the consumers decision how much money should be spent on this basket. In order to find the analogy to the traditional consumer problem, we assume that the mortgage loan repayment is the price we pay for this stream of services. This is in line with Goodman (1988), who presented an analysis of housing demand, accounting for the hedonic value of housing, which considers housing as a good that generates a stream of services. He also accounted for the relation of rents to housing value in consumer decisions.

In our study we consider housing primarily as an asset, generating a stream of services for the owner. Such an approach enables us to analyse the housing market from a macroeconomic perspective, basing our analysis on microeconomic foundations. Only an analysis which rests on correct, realistic assumptions, makes it possible to interpret the market processes and provide useful guidelines for the macroeconomic policy.

Despite housing heterogeneity, we can apply elements of the classical economic analysis that is used to analyse markets of homogenous goods (see Rosen (1974), King (1976) and Goodman (1988)). The assumption that the hedonic function applies to the Polish housing market was confirmed by empirical studies by Tomczyk and Widłak (2010). This allows us to take the market value of each housing unit to the level of an average, one-size housing, characterized by its market value, which is the aggregate sum of the assessment of its features and the expectations of the seller or buyer. Under the implicit markets theory, a home buyer

chooses not only between housing and other goods, but also between particular features of housing. Analysing the equilibrium from the microeconomic perspective, we have to deal with a multi-dimensional problem, which is then reduced to the two-dimensional space in the macroeconomic analysis.

The value added of our article is a well-established demand model with sound microfoundations. Additionally, we present a simple model of housing market cycles which reflects the observed phenomena. We provide a detailed description of the relations between the primary and the secondary market and discuss how, via the multiplier and accelerator effects, even apparently minor demand shocks may generate strong cycles. Our analysis and detailed description of the mechanics of the market should help to improve existing macroeconomic models, i.e. make them more close to reality. This in turn will make their implications more useful for policymakers.

The paper is organized as follows. Chapter 2 discusses the microeconomic foundations for the demand modelling. Chapter 3 is an introduction to the modelling of cycles in the housing market and analyses the relations between the primary and the secondary market. Chapter 4 concludes the analysis.

## 2. Microeconomic foundations of macroeconomic relationships for the modelling of demand in the housing market

Models built on microeconomic foundations (see Heckman, 2010) form the basis for a demand and supply analysis in the macroeconomic context, which allows economists to draw realistic, precise conclusions, which are an useful guide to monetary, fiscal and regulatory policies. The modelling of housing demand, which accounts for the shift from the microeconomic to the macroeconomic perspective, is presented, *inter alia*, by Westaway (1992) and Pain and Westaway (1997). Our article focuses on particular segments of the market, which we then put together. There is a debate going on whether structural models attempting to analyse all parts of the economy should be used or whether the economy should be looked at from a bird's eye view, focusing only on those components which are the object of the analysis (*reduced form model*). Heckman (2010), summarizing the debate concludes that well developed, partial models should be used, which enable an in-depth analysis of the reaction of a part of the economy to particular shocks. We follow suit and present a simplified economy of the housing market, consisting of housing demand and supply. In the entire article we analyse the number of housing units, because the mismatch between housing units desired and housing units available in the market is the measure and determinant of tensions. Moreover, housing cycles usually are driven by the price of housing units and not that much by the increase of rents. For example Levin and Pryce (2009) find that in England and Wales real rents between 1996 and 2007 increased by 9%, while at the same time the ratio of annual rent to the housing price fell from 6,4% to 3%. This basically means that the real housing price doubled and the price increase was much stronger than the increase in rents.

The classical micro- and macroeconomic analysis focuses usually on a representative consumer who spends some of its income on a consumer goods basket. When analysing housing consumption we adopt a similar approach, which is as follows. A single household takes a decision to purchase housing, which may be considered as a basket of goods and services (referred to as H) and spends a part of

its income<sup>1</sup> on it. The home purchase decision can be explained using a decision tree model, as proposed by Kim (2010), where the home buyer's decision is affected subsequently by the price of housing, its location and other features. Limitations of the human brain's ability to process simultaneously a large set of information leads to taking of hierarchical decisions<sup>2</sup> (see Kahn, Moore and Glazer 1987). It should be further emphasised that the decision to purchase a particular dwelling is influenced by both the social standing of the surrounding dwellings and its quality (Phe and Wakely, 2000).

The next step in our analysis is to move from decisions taken by a single household to the whole population of prospective home buyers and the number of housing units actually sold. We assume that one household can buy a large dwelling, another one a small one, and another one will not decide to purchase housing at all or will buy more than one housing unit. The household's decision to purchase a particular housing unit, in a particular location may be treated as a discrete decision (see Anas, 1982, 1990). As there are many prospective buyers we can use the law of large numbers to move from the individual purchase probabilities to proportions in the whole population. Each household is assigned a vector of purchase probability of housing at a given price<sup>3</sup>, by which we get the home purchase probability of the whole population. Finally, multiplying this result by the number of households in the market, we obtain the number of housing units that are demanded. Although dwellings differ in size, in the short and medium perspective the size of an average housing unit sold remains stable (see NBP 2012). This way, we move from individual demand to total demand in a particular market, which is measured with the number of housing units.

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1 In practice, this purchase decision is more complex. A household takes into consideration many features such as the housing location, its look, number of rooms, etc. This issue may be solved with the use of the hedonic model (see Tomczyk and Widłak 2010).

2 Consumers' hierarchical decisions are widely analysed in the marketing literature (see Kahn, Moore and Glazer 1987 and Fotheringham 1988). Kahn, Moore and Glazer (1987) analyse such a problem using the example of a refreshment drink, taking into account various conditions influencing the purchase decision.

3 Based on his empirical analysis, Carter (2011) concluded that the home purchase probability depends on the household's income.

## 2.1 Demand side modelling

This chapter presents a selective review of micro-founded models that are used for the analytical description of the demand side in the housing market. We start with a simple model of optimal income allocation between housing consumption and consumption of other goods. An important and empirically justified assumption is that a household finances the home purchase through a mortgage. We assume that under fixed instalments, the annual cost borne by a household<sup>4</sup> is the size of housing  $H$  times its price per square meter  $p$ , multiplied by the interest rate  $r$ , thus  $rpH$ . This cost plays a dominant role in the decision to buy housing. We explain the decision making process in the next part.

### 2.1.1 The simplest model – rule-of-thumb consumer

The analysis starts with a household which currently decides what part of its income to spend on housing and what part on other goods. The household utility results from housing consumption  $H$  and consumption of other goods  $C$  and additionally, from the expected wealth growth as measured by the housing appreciation. In our model, the utility function has been selected in such a way as to analyse a realistic problem faced by consumers and moreover, to allow its analytical solution. The utility function takes the form of the CES function, whereas the parameter  $\theta$  is the weight that a consumer attaches to the consumption of other goods and the parameter  $\mu$  is used to set the elasticity of housing substitution with other goods.

$$U(C, H) = (\theta C^\mu + (1 - \theta)A^\gamma H^\mu)^{\frac{1}{\mu}}$$

The substitution elasticity is calculated as  $\epsilon = \frac{1}{1-\mu}$ . Further on, the parameter  $\gamma$  determines how strong the future appreciation or depreciation of housing affects the consumer's decision. The appreciation is calculated as the ratio of the next year's

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<sup>4</sup> It can be assumed that home maintenance costs are proportional to the home size and its price. Because whether they are included in the model or not does not drastically change the conclusions, which follow from the model, they will be ignored for simplicity reasons. Yet, as loans are usually repaid in fixed instalments, the interest payment is the dominant part of repayment in the first few years (in Poland the loan maturity is usually 25 years). Therefore, the model includes, as housing costs, the interest rate part of the loan repayment, which is the interbank interest rate plus the bank's margin, and in the case of foreign currency denominated loans, exchange rate fluctuations.

expected price to the current price  $A = \frac{p_{t+1}}{p_t}$ . Housing appreciation was included in the utility function by, *inter alia*, Dunsky and Follain (1997) and Sommervoll, Borgensen and Wennemo (2010). An expected price increase has a positive impact on the house purchase decision, whereas housing depreciation has an adverse effect. The consumer has to obey the following budget constraint:

$$b = rpH + C$$

In order to find the consumer's equilibrium and the optimal choice of housing consumption under a given interest rate, price and preferences, we solve his problem using the Lagrange equation.

$$\mathcal{L} = (\theta C^\mu + (1 - \theta)A^\gamma H^\mu)^{\frac{1}{\mu}} + \lambda(b - rpH - C)$$

In this way, we obtain the optimal substitution between housing consumption and consumption of other goods.

$$(1 - \theta)C^{\mu-1}rp = \theta A^\gamma H^{\mu-1}$$

In combination with the budget constraint, we obtain the demand function for housing and other goods under a given income, interest rate and housing price.

$$C^* = \frac{b}{1 + rp \left( \frac{1 - \theta}{\theta} rp \frac{1}{A^\gamma} \right)^{\frac{1}{\mu-1}}}$$

$$H^* = \frac{b}{rp + \left( \frac{1 - \theta}{\theta} rp A^\gamma \right)^{\frac{1}{1-\mu}}}$$

The income elasticity of demand is approximately 1 (see, *inter alia*, Lin and Lin 1999), which means that a rise in income or loan affordability results in a proportional growth in housing demand. In addition to the consumer income and substitution effects, the increase or decline in the number of households eligible for a loan, according to prudential regulations, will affect the demand.

This model, calibrated to the Warsaw market in order to analyse the effects of various shocks, is presented in a complementary article (Augustyniak, Łaszek and Olszewski, 2012).

### 2.1.2 The permanent-income-hypothesis consumer

The previous model can be easily extended to account for decisions in the life cycle, which we do basing on the Aoki, Proudman and Vlieghe (2002) model. As our aim is to provide a simple and analytical description of cycles in the housing market, we only make use of selected parts of their detailed and complex model. Specifically, we focus on the permanent-income-hypothesis consumer. This consumer owns always one dwelling, yet, may increase or decrease his housing expenses in the future by changing the housing size. Moreover, this consumer can save now ( $S_t$ ) to increase his consumption in the future ( $C_{t+1}$ ). His aim is to maximize his utility during the whole life cycle. In order to account for the consumer's life-cycle decision, we should remember that utility varies over the time horizon, and needs to be discounted with the parameter  $\beta < 1$ . The time index  $t$  denotes in this model longer periods of time, not necessarily single years. For example, a young couple with a limited budget will initially buy a small dwelling. Yet, as children are born and, moreover, the couple's income rises, it decides to sell the old dwelling and to buy a new, bigger one. The household's problem can be written as follows:

$$\max U(C, H) = \sum_{t=0}^{\infty} \beta^t (\theta C t^\mu + (1 - \theta) H t^\mu)^{\frac{1}{\mu}}$$

under the intra-temporal budget constraints

$$b_t = c_t + r_t p_t H_t + S_t$$

and

$$b_{t+1} + (1 + r_t) S_t = c_{t+1} + r_{t+1} p_{t+1} H_{t+1}$$

from which follows:

$$b_{t+1} + (1 + r_t)(b_t - c_t - r_t p_t H_t) - c_{t+1} - r_{t+1} p_{t+1} H_{t+1} = 0$$

As above, this problem may be solved using the Lagrange equation:

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t (\theta C t^\mu + (1 - \theta) H t^\mu)^{\frac{1}{\mu} + \lambda} (b_{t+1} + (1 + r_t)(b_t - c_t - r_t p_t H_t) - c_{t+1} - r_{t+1} p_{t+1} H_{t+1})$$

and we obtain the optimal inter-temporal substitution:

$$H_t^{\mu-1} = r_t p_t (1 + r_t) H_{t+1}^{\mu-1} \frac{\beta}{r_{t+1} p_{t+1}}$$

$$C_t^{\mu-1} = (1 + r_t) C_{t+1}^{\mu-1} \beta$$

and also the optimal intra-temporal substitution:

$$(1 - \theta)H_t^{\mu-1} \frac{1}{r_t p_t} = \theta C_t^{\mu-1}$$

$$(1 - \theta)H_{t+1}^{\mu-1} \frac{1}{r_{t+1} p_{t+1}} = \theta C_{t+1}^{\mu-1}$$

Solving the household problem, we obtain the optimal inter and intra-temporal choice of the housing and other goods.

### 2.1.3 Demographics-based model

Housing demand is also affected by such fundamental factors as demography or migrations. Demographical changes shift the aggregate demand curve, increasing or decreasing the number of households willing to purchase housing. Based on the function developed by Waldron and Zampolli (2010), the augmented housing demand function, accounting for the number of persons in a household  $N$  and assuming an inter-temporal rate of substitution of  $\varphi^{-1}$ , looks as follows:

$$U(C, H, N) = \frac{N}{1-\varphi} \left( \theta \left( \frac{C}{N} \right)^\mu + (1 - \theta) \left( \frac{H}{N} \right)^\mu \right)^{\frac{1-\varphi}{\mu}}.$$

As a result of such extension of the utility function, housing demand will usually grow along with a bigger number of household members.

## 2.2 Optimal allocation with a kinked budget constraint

All the models presented so far assumed that a household may take out any loan, provided it meets its budget constraints. Yet, as due to prudential regulations banks impose certain restrictions on the borrower, the amount of available loan may be considerably reduced. This situation concerns practically all countries, in particular, fast developing emerging economies where the housing stock is rather small with respect to income and there is a strong need for mortgage-financed homeownership. Given prudential regulations, a household may spend only a part of its income on loan repayment:  $b_H = kb \leq b, k \in (0,1)$ . Thus the budget constraint is kinked and two cases of consumer decisions on housing expenditure should be considered:

$$H = \begin{cases} H^*, & rpH^* \leq kb \\ \frac{kb}{rp}, & rpH^* > kb \end{cases}$$

The kinked budget line has also an evident impact on the optimal demand for other goods, which takes the following form:

$$C = \begin{cases} C^*, & rpH^* \leq kb \\ (1-k)b, & rpH^* > kb \end{cases}$$

Provided the optimal point is unavailable due to lending restrictions, the consumer will have to adjust its consumption accordingly - it will consume less housing and more other goods than it would like to. This, in turn, leads to very strong demand shocks. Should interest rates fall considerably, the mortgage-financed loan availability would rise. As suggested by the data on the Polish market (see NBP (2011) and (2012)) as well as the analyses conducted by Brzoza-Brzezina, Chmielewski and Niedźwiedzińska (2010), households in Central and Eastern European countries easily substituted domestic loans bearing high interest with foreign currency denominated loans bearing a lower interest rate, however failing to account for the high FX risk.

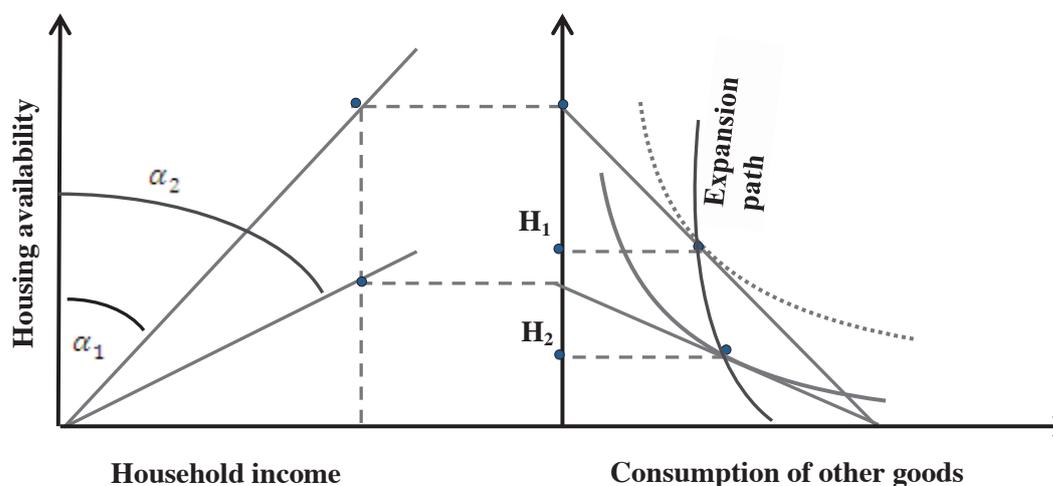
### **2.3 The impact of the credit channel on the situation in the real estate market**

Taking into account the previously discussed demand models, we present how demand is affected by changes in income, prices, interest rates or prudential regulations. The financial sector affects the housing sector through the credit channel, where the basic parameter affecting housing demand are interest rates and related real and alternative costs of capital as well as bank's prudential requirements, including the initial down-payment.

The value of capital, namely housing, is transformed through the interest rate into a monthly stream of payments. It constitutes the financial cost of home ownership in the form of loan repayment or alternative costs of owner occupied housing. Basing on the market price and their own preferences, households choose a basket of goods. If housing is considered as a capital good that generates services, its price is the monthly ownership cost (interest on the mortgage or alternative cost of capital) as well as maintenance costs (Figure 1).

A change in interest rates reduces consumption through the substitution and income effect. The substitution effect includes both a growing demand for substitutes, namely rented housing (left out to make things simple) and changes in the consumption structure towards a higher share of other consumer goods. The income effect, on the other hand, will limit or increase housing consumption.

Figure 1. The effect of the financial sector on housing consumption



The home purchase decision is affected by interest rates and the required down-payment. Already in the beginning of the 1970's Burnham (1972) quotes the findings of the Fed's analysis, which demonstrated that mortgage supply is one of the most important, if not the key factor affecting home construction. This relationship still holds (see Aoki et al., 2002 and Levin and Pryce, 2009) and we assume that it will hold in the future, too. Apart from checking the creditworthiness of the buyer, the bank requires an initial down-payment. The empirical analysis by Jaffe and Rosen (1979) and Stein (1995) shows that the amount of down-payment greatly impacts both home prices and subsequent decisions to change housing. According to Ortola-Magne and Rady (2006) the down-payment is of great importance for young households who buy their first housing. Further on, Rubaszek (2012) analysed the restrictive impact of the down-payment requirement on the welfare of households in Poland. He demonstrated that a higher down-payment requirement considerably delays the home purchase, which translates into delayed home changes and reduces the household's utility during the life cycle. While the



preventing consumers from reaching their optimum, housing demand will rise along with loan availability (Figure 2b). With the normal budget line, rising income translates proportionally into housing demand (from A to A'). Yet, with a kinked budget constraint, the consumer has a suboptimal allocation of consumption and a rise in income leads to a nonlinear increase in loan availability<sup>5</sup> and generates a demand shock. The consumer does not only spend this additional income on housing, but moreover can give up some consumption of other goods to spend even more on housing (housing consumption moves from B to B'' instead only to B').

This phenomenon accounts for the fact that lending follows aggregate loan availability and mortgage-financed housing availability, a process observed for many years in the Polish market (see Łaszek, Augustyniak and Widłak (2009) and NBP (2012)). A rising demand brings mainly price effects as demand for housing is rigid in the short-term. If along with rising home prices, banks ease their loan restrictions, housing demand may remain stable or even grow until it reaches the consumer's equilibrium point (the consumer will choose the allocation B' rather than B, Figure 2c).

The described relations concern buyers of new housing who will be affected by home price increases through the rise in the amount of cash and lending necessary to finance housing. In the case of home owners, a further price growth should urge them, through the substitution effect, to attempt to capitalize on growth in value and replace their housing with a smaller, lower-priced housing. Consequently, a growing supply should improve the situation in the market. However, high transactions costs<sup>6</sup> in this market and consumer habits are factors

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<sup>5</sup> Loan availability is usually calculated as a given share of disposable income. Under a constant social minimum a rise in income makes the disposable income and thus loan availability rise more than proportionally to the income growth, especially at low income levels.

<sup>6</sup> A home change entails costs – both direct and indirect financial and moral costs. Financial costs may account for up to 15% of the housing price and they include transaction costs resulting from various fees. Moreover, upon moving, the cost may be increased due to rents that are paid during the home refurbishment period. Indirect costs include home refurbishment costs of the sold house, which may be lost as the new owner may have totally different preferences and may want to renovate the dwelling again. We should also add non-financial costs resulting from being accustomed to neighbours and the residence area.

curbing this phenomenon. The home owner usually agrees to the change, if the additional profit or utility of new housing significantly exceeds the above mentioned costs.

Yet, even very high price increases do not always lead to massive home sales. A change in the value of housing means also a perceived change in consumption of housing. Under such conditions the consumer will shift its preferences towards housing. Consequently, housing demand will be maintained at the current level (the home owner will not sell the higher-priced housing). His preferences should change in such a way that the substitution effect of the rising home price (reduction of housing consumption and boosting consumption of other goods) is offset with the income effect (income growth results in consumption of higher-priced housing, Figure 2d). In Poland, the boom period brought a rise in the volume of transactions in the secondary market, thus we may have observed both types of behaviour in the market.

#### 2.4 Moving from individual demand to aggregate demand

When aggregating the behaviour of individual consumers, we obtain a function of demand for housing units which, at a given price, is inversely proportional to the housing price or the interest rate. Multiplying the housing demand of an individual household  $H_t^*$  by the number of households in the economy  $N$  and dividing this value by the size of an average housing unit in square meters  $\overline{H}_t$ , we obtain the aggregate demand for the number of housing units:  $D_t = H_t^* N / \overline{H}_t$ . In the long-term equilibrium, the number of housing units sought-for will equal the long-term size of housing stock, called  $S_t$ . However, in the short run demand can fluctuate, due to changes in preferences, demographics or the interest rate. We show how a reduction of the interest rate leads to an aggregate demand shock in the short run. As previously discussed, interest rate changes strongly affect the demand through the credit multiplier, being the product of the interest rate before and after its change. For example, an interest rate reduction by 1 percentage point from 4% to 3% means a 25% fall in actual home purchase costs, if it is financed with a mortgage. In such a case a significant share of households, who previously were not able to afford

housing but had a strong need to buy it, will now be able to buy it. This means that the aggregate demand for housing rises very fast and this demand will not be satisfied by the current supply, which is inflexible in the short run.

## 2.5 The supply side and price adjustments

After having examined the demand side, we analyse the supply and price reactions to demand changes. The stock  $S_t$  of housing units consists of the depreciated stock from the previous period ( $d$  is the depreciation rate), which is restored through new housing construction  $I_t$  (see: Sommervoll, Borgensen and Wennemo 2010):

$$S_t = S_{t-1}(1 - d) + I_t$$

In the long-run equilibrium, the production of new housings equals its depreciation, thus the housing stock remains constant. Moreover, the stock  $S_t$  equals demand for housing  $D_t$  in the long run. If, on the other hand, for reasons mentioned above, demand for housing increases to exceed housing supply, prices start to rise. The price adjustment, which results from the demand and supply mismatch, can be simply described by the following formula (see Tse, Ho and Ganesan 1999):

$$\Delta P_t = \rho \left( \frac{D_t - S_t}{S_t} \right),$$

where the parameter  $\rho$  determines the price response elasticity to the mismatch (it may be asymmetrical downwards and upwards). As a result of the price growth, real estate developers increase the housing production. A very important fact for the price adjustment is that the demand shock concerns a large part of the whole housing stock, while new housing production concerns its marginal part only. The relationship between new housing construction and the housing stock may be denoted as  $f = I_t/S_t$ , a parameter which usually has a value of several percentage points. The inverse of this parameter, which we call the fundamental multiplier, causes that even a minor change in housing stock demand generates a shock to the demand for new housing production. This results in a huge jump in prices and urges developers to increase production.

Real estate developers often extrapolate the historical price increase, assuming that if prices are on the rise this year they will also increase in the future. Their production function depends on the previously observed rises in prices and

surges in production costs. A more detailed analysis of the developer's construction process and its financing can be found in Augustyniak et al. (2012), here we make the construction process and related decisions as simple as possible. The real estate developer in Poland usually puts a pre-sale<sup>7</sup> contract on sale when the construction process has been started and the completion of the real estate is scheduled in approximately two years. At times of very high demand and strong price increases, even contracts for newly commenced investment projects, the so-called holes in the ground get sold. We modify the housing production function proposed by Tse, Ho and Ganesan (1999), adjusting it to empirical observations. The real estate developers production consists of its autonomous production<sup>8</sup> and production that depends on the lagged price change  $\Delta p_t$  and lagged construction costs  $C_t$ :

$$I_t = \alpha_0 + \alpha_1 \Delta p_{t-2} + \alpha_2 \Delta p_{t-1} - \alpha_3 C_{t-2}$$

Substituting the number of housing units newly built by developers into the previously discussed housing stock equation, we obtain the motion of the housing stock:

$$S_t = S_0 + \alpha_1 \Delta p_{t-2} + \alpha_2 \Delta p_{t-1} - \alpha_3 C_{t-2}$$

This simple model explains the occurrence of cycles in the housing market in the following way. Let us assume that interest rates are on the decline, which along with a kinked budget constraint will result in a leap jump in housing demand. In this way, falling interest rates will boost capital flows from bank accounts to the owner occupied housing sector. These phenomena have been shown empirically by Levin and Pryce (2009). Under short-term fixed housing supply prices start to grow quickly. Real estate developers monitor the price increases, calculate potential profits and embark on new constructions. After approximately two years, they put pre-sale construction contracts on sale. As they are unable to precisely estimate future demand and do not know exactly the volume of competitive construction, at some point, they start to build too many housing units. When supply is considerably in excess of demand, prices start to fall and the downward phase of the housing

<sup>7</sup> Such pre-sales are not very usual in Western Europe, however they are common in Poland have been used for a long time in Asia (see Chang and Ward 1993).

<sup>8</sup> With high, fixed costs, real estate developers build some housing as a reserve, failing to account for current prices and volatile costs. Such a production is called autonomous production.

cycle starts. Real estate developers notice that home sale slows down and additionally, amidst falling prices and generally rising costs, their profit margin falls. Developers limit new housing production waiting for prices to embark on an upward trend and for a new housing cycle to begin.

In the next section we explain the modelling of housing cycles in more detail.

### 3. Introduction to the modelling of housing market cycles

Basing on the previously presented microeconomic foundations of the demand and supply side behaviour, we now present the interactions at the macroeconomic scale. We first sketch the fundamentals of the housing market and then show how to move from a long run equilibrium housing model to one that is able to explain cycles in the short and medium term.

In the case of residential real estate the creation of supply in the short term is generally very limited and any changes in demand translate into demand for new construction. It should be mentioned that when discussing supply adjustments, namely adjustments of the size of the housing stock, given the relatively small annual stock increases (1-3%), we mean a perspective of several years or even decades and a similar length of supply cycles. As demand is cyclical and volatile, supply does not match demand. Yet, there have been cases when, especially with the government's intervention, long-term economic growth has been accompanied by a large, long-run supply of new housing investment projects. Taking the considerably high volatility of demand into consideration, it may be concluded that the market will only seek to reach the equilibrium, usually failing to achieve it. Downward adjustments are much more difficult as they result from stock depreciation, which is usually inferior to the size of new construction. In the case of major structural mismatches, the downward adjustment may take a long time.

Basic models of the real estate market usually deal with real estate for rental. As a starting point for the later analysis we briefly describe the well-known DiPasquale and Wheaton (1992) model (DPW, hereafter), in which the real estate stock generates services, and related rents are valued in the capital market, which determines real estate prices. In this model, the key point is the relationship between the rent level of real estate and its price, and, consequently, the volume of production or housing stock depreciation and the equilibrium between demand for housing space and its supply. In the DPW model, demand shocks in the short run

lead only to price growth through the imputed rent channel<sup>9</sup>, as the housing stock, and consequently, supply is constant. The high prices translate in the long run into supply growth<sup>10</sup>, and further into capital inflows to the sector, generating extraordinary profits and a further supply growth. The growing supply leads to the decline in prices, the fall in rates of return and finally the return of new construction to its long-run equilibrium levels. In this model supply is rigid in the short run and becomes flexible in the long run as construction effects accumulate over the years. The housing space market in the DPW model is in a long-term equilibrium when the demand for housing space translates into a rent which ensures that the housing price, understood as discounted rents<sup>11</sup>, will stand at the level of long-term production costs and will guarantee a production level offsetting the housing stock depreciation.

However, the discussed DPW model and its adaptations constitute equilibrium models in the housing space market rather than short-term speculation and imbalance models in the market for housing units. In order to analyse the disequilibrium in the market, we propose a housing model, which is focused on owner occupied housing units and a short period of time.

### 3.1 The owner occupied housing model

When analysing short- and medium-run housing cycles, we need to focus on owner occupied housing units. The household's need to buy a dwelling can be only satisfied with a dwelling from the existing stock or a newly constructed dwelling. While adjustments in the rental market are relatively smoother and faster<sup>12</sup>, rising

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<sup>9</sup> Imputed rents are rents that the home owner would have to pay for a similar housing if he wanted to rent it as a consumer. Therefore, the housing value can be expressed as follows:  

$$value = \frac{rent}{1+r} + \frac{rent}{(1+r)^2} + \dots + \frac{rent}{(1+r)^t}$$

<sup>10</sup> The price elasticity of supply and its estimated values for various countries are presented by Phang, Kim and Wachter (2010). Moreover, the investment in and construction of new residential real estate were presented in theory and estimated by Topel and Rosen (1988).

<sup>11</sup> It should be noted that the home owner as a consumer will be in equilibrium if imputed rents equal interest rate payments. This means that the ownership cost equals gross rent, and consequently, there is no arbitrage and the rental housing stock and occupier owned housing stock will be in equilibrium. If ownership costs exceed the imputed rent, the owner will not be in equilibrium as a real estate developer, and, in the opposite case, as a consumer.

<sup>12</sup> The rental housing market, including also the professional one, is subject to tenant protection rights, providing different degrees of protection and limiting the possibility of changing the contract

demand for owner occupied housing leads very quickly to price surges and construction booms. Those lead to short- and medium-run cycles in the housing market.

The DPW model can be relatively easily augmented from the rental model to the owner occupied housing model (OOH), which we propose and explain in more detail. It is enough to apply the imputed rent instead of the usual rent. Although the DPW model did not account for the credit channel, it can be easily included in our augmented model with the use of the relationship between the housing market and the capital market. In this perspective, the capital market provides capital that is transformed into housing, and further on, through the interest rate, it transforms the housing stock into a stream of payments borne by the home owner.

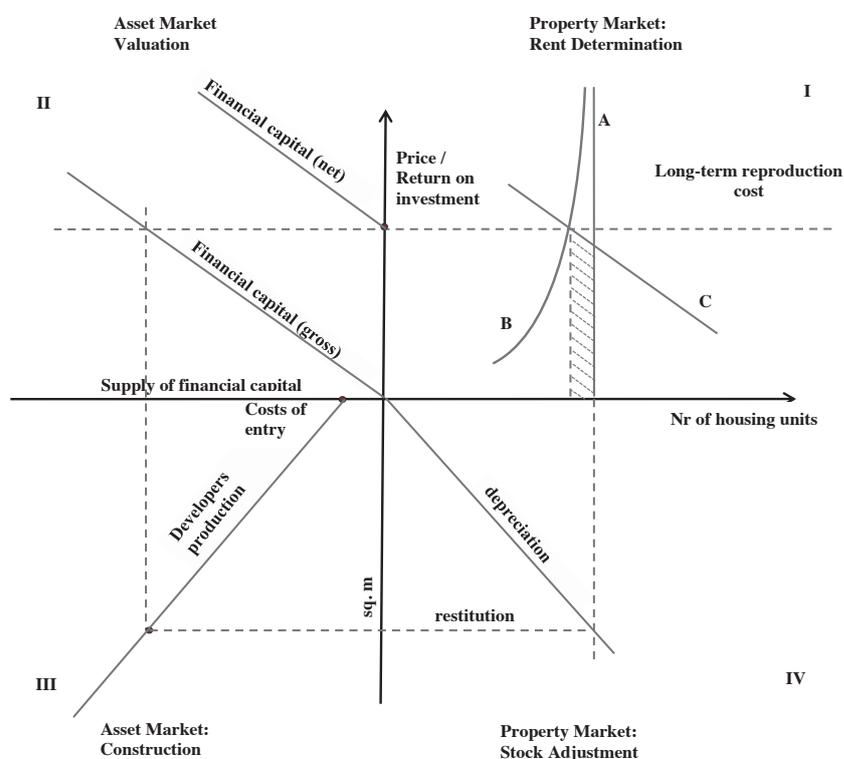
The starting point for our model is the fact that the housing market is in disequilibrium and the equilibrium state is more an exception rather than a rule. This is the result of a quite inelastic short-term housing supply which becomes flexible with a time lag, the volatile demand, its relationship with the financial market and finally, speculations. First, we present the long-run behaviour of the market and subsequently explain how it changes as the time period becomes shorter.

Our OOH model bases on the DPW model and, as an equilibrium model, it focuses on the long-term perspective. Its four parts can be illustrated with a system of coordinates presented in Figure 3. The first quarter is the housing market, represented by the housing units stock that is used to generate a stream of utility. The second quarter is the market of financial capital which flows to the housing sector if the rate of return is sufficiently high. The gross capital inflow is used for the replacement of depreciated housing stock, whereas the net capital flow adds new housing units to the stock. The third quarter is the real estate development and construction market which transforms financial capital into real capital, i.e. housing. The fourth quarter represents the stock depreciation and reconstruction, finally affecting the stock level in the first quarter.

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during the rental period. Still the adjustments in the rental market are much more simple and faster than those in the owner occupied housing market.

Figure 3. The OOH market model, which bases on the DiPasquale-Wheaton (1992) model.



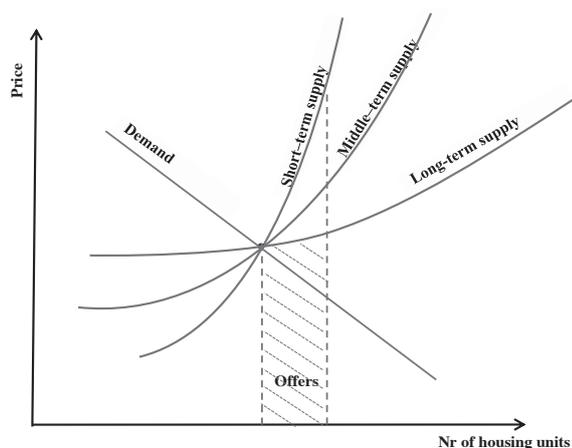
The real capital market, i.e. the housing units market, is in its long-term equilibrium when the current, commercial and available supply intersects its alternative uses, setting the price per unit of capital, its rental cost and the number of vacancies at such a level that the related real estate development production offsets the stock depreciation. In this situation, enterprises are no longer motivated to enter the real estate development sector. However, a demand shock boosts prices as supply is almost rigid in the short run. The price growth leads, through the financial market, to a lagged supply growth.

In the subsequent parts we explain the behaviour of the supply in the primary and secondary market at various time horizons, which helps us to explain the occurrence of cycles in the OOH market.

### 3.1.1 Supply in the primary market in relation to time

In the short term, the supply in the primary market consists of still unsold newly constructed housing units and a relatively inelastic new construction that was planned in the past. In the medium term, the supply of housing units will increase, as developers may plan in advance larger production volumes. In the long term, new capital may flow into the construction sector, boosting its production capacity and setting costs at the average cost level. The housing supply gets flexible with time, provided that new housing construction offsets depreciation, namely if prices offset long-run production costs. The longer the period, the larger becomes the aggregate supply of new housing stock and the higher is its elasticity, thus the supply curve is getting flatter and flatter (see Figure 4).

Figure 4. Short-, medium- and long-run equilibrium in the market for newly constructed housing units



We explain the behaviour of developers in more details. In the short term the supply of real estate developer housing is rigid on the back of the period of up to 4-5 years necessary to launch and commercialize the construction project. Yet, developers do have certain price expectations and are usually prepared to wait for a client that will pay the expected price (see the offers depicted in Figure 4). Frequently, when real estate developers finance housing investment with bank loans, due to the loan agreements, they cannot lower the price to suit market conditions. Thus, their supply

curve will be inclined and there will always be some housing stock unsold. Supply in the medium term will be flexible as real estate developers will start selling pre-sale contracts for housing, provided this is permitted by the law and accepted by the market. Generally developers put pre-sale construction contracts on sale after they started the construction process<sup>13</sup> and it takes around 2 years until the housing is completed. During a price boom, the selling of pre-sale contracts may start even earlier and buyer purchases a so-called hole in the ground. In the medium term (i.e. after 3-4 years) new completed housing units are delivered. However, this may not affect the market if this is a contract market rather than the market of objects, as those housing units have been already sold in the past. The developer's supply curve will always start from the minimum profitable production (minimum marginal costs) which will rise together with production growth (growing costs of materials and workmanship in the short term).

The relationship between housing production costs and the supply curves in the real estate development sector needs to be explained in more detail. In the medium term, the real estate development sector is capable of providing more dwellings at higher costs, thus the cost curve will be close to aggregate marginal costs in the real estate development sector. The medium term supply curve in the real estate development sector (developers plan future investments based on current prices) may, as shown by empirical observations, differ considerably from the analysed cost curve. Real estate developers generally underestimate the rise in the costs of production factors driven by rising demand and only react to nominal effects. Moreover, developers usually operate amidst a high financial leverage which changes the profitability ratio as the growth of production financed in such a way offsets the rising unit costs. In some countries, it is possible for the developer to finance construction costs with the buyer's pre-payments, usually without paying interests, which increases the investment profitability. As a result, the supply of real estate development pre-sale contracts may be, in the short term, considerably more elastic in terms of price growth than marginal costs are.

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<sup>13</sup> The realization of the housing development project in Poland takes around 4-5 years. In the first 1.5-2 years the developer buys land, obtains building permits and related documents. The construction process takes another 1.5-2 years and the completion of the investment and sale of finished housing units takes another year (see Augustyniak et al. 2012).

In the medium term, capital will flow into the sector, pushing costs towards the minimum average cost level (long-term costs) and, consequently, the supply curve will get even more elastic. In practice both processes will be observed, namely new firms will enter the market and incumbent firms will increase their production. If the level of supply growth exceeds a certain value of the existing stock, average costs will rise on the back of tensions arising in the economy (transportation, materials, land, infrastructure, etc.). In the very long period housing supply will get flexible through the aggregation of annual construction effects. The entire economy will undergo structural adjustments aimed to match housing supply with the sector's needs<sup>14</sup>.

Basing on our own observations, we assume that in the long term the market will trigger mechanisms that will offset the supply and demand mismatch in the local markets through new construction and housing stock depreciation. As annual supply changes represent insignificant percentage points of the housing stock, whereas demand changes are considerably larger, these adjustments may take decades and are generally unlikely to result in an equilibrium. To a certain extent, we also have to do with adjustments through the competition of local submarkets attempting to solicit investors and attract demand. As a result, local submarkets in terms of new supply and current changes in demand will always be somewhat unbalanced.

### **3.1.2 Supply in the secondary market in relation to time**

In the short term, the supply in the secondary housing units market is rather inelastic, however it may be increased as a result of growing real estate prices. Growing housing prices should urge households to change their existing dwelling into a smaller one or hasten their decision to sell the dwelling, should the substitution effect outweigh the income effect. Yet, transaction costs or the fact of housing being considered a consumer good will be strong enough to finally put an

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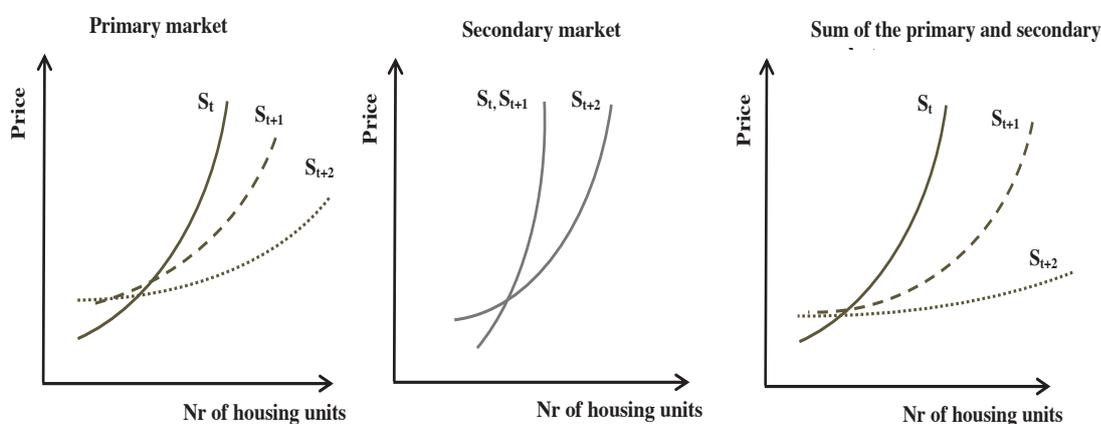
<sup>14</sup> It should be added that economy may face erroneous, socially expensive and excessive adjustments to suit construction. This was last observed, inter alia, in Spain. Considerable productive capital and human capital was used for housing purposes which has been translated into enormous costs generated by vacant buildings and mismatches in the labour market.

end to this trend, as empirical evidence shows. Supply in the short and medium run will probably be not very flexible; it will get flexible in the long run only through changes in the use of housing units<sup>15</sup>, large-scale migration as well as owners' deaths.

### 3.1.3 Total supply in relation to time and prices on the secondary and primary market

The total market supply is the sum of supply of new constructed housing, pre-sale development contracts and supply from the secondary market. The supply in the short-term is different than the one in the long-term, both as regards new construction and the existing stock where in lieu of housing stock there are dwellings put on sale. The supply in the primary, secondary and the total market in the short term ( $t$ ), medium term ( $t+1$ ) and long term ( $t+2$ ) is shown in Figure 5.

Figure 5. Supply of housing in the short term  $t$ , medium term  $t+1$  and long term  $t+2$  in the OOH market.



In the short and medium run, supply may be defined in a classical way, i.e. as the number of housing units that households are ready to put on sale at a given place, time and price and also those that have been put on the market by real estate

<sup>15</sup> The housing stock is highly diversified both across countries as well as within a particular country. Moreover, as a result of changes in the pursued housing policy they get further diversified with time. In most countries owner occupied housing dominates the housing stock; yet, in many countries also rental housing, including municipal housing or mixed ownership housing has a large share in the housing stock and strongly affect the whole sector.

developers at a given place, time and price, taking into account their price in the past. The so understood supply will consist of two components: housing put on sale from the existing housing stock and new real estate development construction<sup>16</sup>.

We should address in more detail the emerging problem of the non-linearity between rising demand for housing and the price and supply reactions. Its consequence is the mechanism of the direct allocation of capital to the housing sector and the impact of the financial sector and the related allocation of capital through the financial sector.

Due to the non-arbitrage condition between the primary and secondary housing market, dwellings of similar quality and technical condition should be priced similarly. Yet, the non-arbitrage condition is usually disturbed by fiscal policy (taxes, subsidies) and regulations. In addition, housing offered in the primary and secondary market generally differs in terms of dwelling characteristics and ownership status. Also, developers are more price flexible than sellers in the secondary market and can often encourage homebuyers to purchase homes above their market value. However, in case of oversupply, developers are willing to sell dwellings below secondary market prices, if they sold previously enough housing units at higher prices.

Due to the imperfect non-arbitrage condition, the primary market price in most local markets is usually slightly higher than the equilibrium price, and the secondary market price is a little bit lower (see NBP 2012). This results from real estate developer's marketing opportunities to convince the client of the higher value of a particular dwelling.

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<sup>16</sup> In practice, the supply curve not only lacks the character of a continuous line but may turn out to consist of several lines indicating stock available for alternative use in various time horizons or even several sub-markets separate from one another, presenting a different scale and form of interaction. In order to solve this problem, the model should be limited to the stock available in a given period for alternative commercial use. This stock will generally consist of rental housing and the OOH market as in the first market contracts may be concluded on a rather fairly basis, especially without excessive time limitations whereas the other housing stock may be converted into rental housing or non-housing stock. In the case of restrictions in the rental market and generally related shortage of this kind of housing, the best idea is the assumption that only the OOH stock is analysed.

### 3.2 A simple model of the cycle and policy implications

Basing on the previously described behaviour of households and developers in the residential real estate market, we analyse a demand shock driven cycle. In the literature it is generally assumed that business cycles are driven by exogenous shocks and we apply this idea to the housing cycle. Due to the specific character of the residential real estate market its cycles are inevitable.

The major housing cycles generators are multipliers which cause that even minor changes in certain macroeconomic factors result in strong fluctuations in the whole housing market. For example as discussed in section 2.4, a minor decrease in interest rates translates through the credit multiplier into a strong increase in demand for nearly the entire housing stock. Households that would like to buy a dwelling but could not afford it will now be able to buy it. Also those who already own a housing unit might consider to buy another one. We should remember that the growth in demand concerns nearly the entire housing stock whereas the primary market supply is a mere fraction of the whole stock. Therefore, the credit multiplier effect is additionally strengthened by the fundamental multiplier, presented in section 2.5. Under the assumption of a rigid short-term supply, this multiplier is defined as the ratio of current demand for housing from the primary market to its current supply. On average and in annual terms, the supply from the primary market in Poland has a size of 1% of the whole housing stock and satisfies demand for new housing as well as it replaces the depreciated housing stock. The standard rate of stock replacement is below 1% which means quite conventionally, that an average housing unit lasts for at least 100 years. Yet, the replacement demand is generally nonlinear and accelerates during a construction boom. This means that the effect of a demand shock persists. Around 2% of the housing stock are traded in the secondary market, thus if there are no demand shocks driven by growing income, migration or changes in the interest rate, around 3% of the housing stock are traded and the aggregate demand for housing is satisfied.

However, let us now suppose that the economy is accelerating. As shown by numerous studies, with low GDP and, consequently, low levels of housing needs satisfaction, the income elasticity of demand for housing may approach 1 (see Lin

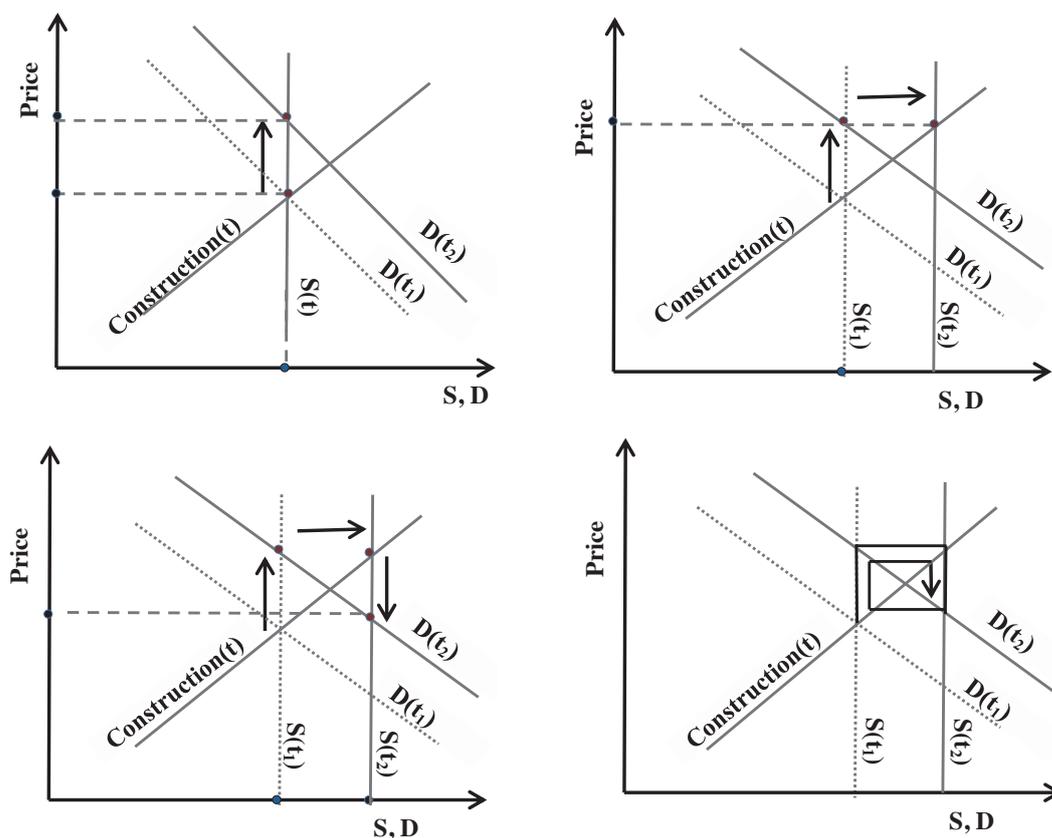
and Lin, 1999). With a 5-6% GDP growth, which corresponds to a 4-5% income growth, the aggregate demand for housing is likely to increase from 3% to 5% of the whole stock in year-on-year terms. As only around 2% can be satisfied from the secondary market, another 3% need to be delivered from the primary market. However, as the primary market constructed on average housing units that account for 1% of the stock, their production should triple, which is basically impossible in the short run. As supply is inflexible, prices go up quickly and can even double. Consequently, real estate developers embark on long-term investment projects, consumers strive for a better place in the waiting list for housing and pre-sale construction contracts and rights thereto are traded. To speed up the contract realization, developers start to purchase ready-made projects from competitors, thus trigger a boom in the sector.

Another example is a demand shock that is triggered by the reduction of interest rates. Even a small reduction of interest rates, as discussed earlier, leads to strong increases in loan availability and boost demand for housing. We think that this effect has not yet been adequately accounted for in the central bank's monetary policy, yet its impact may be significant. We explain the effect of the accelerating impact of an interest rate reduction on housing demand growth and the real estate development market with the following example. To achieve the objective of stimulating economic growth, the central bank cuts its interest rates over a given period by 2 percentage points, i.e. from 4% to 2%. This effect translates not only into the aggregate demand in the economy, but also causes a nearly twofold increase in the availability of mortgage loans, which, amidst given income also doubles the demand for the housing stock. Consequently, home prices will double and speculative price bubbles start to emerge in the market. The discussed example may be extended to include GDP growth-induced migration, or an additional shock caused by a marriage boom.

These phenomena show that in countries with a low level of development and strong housing needs, loan availability and availability of mortgage-financed housing can be a good measure of demand. They also explain the credit boom phenomenon in the situation of changes in loan availability leading to significant

changes in demand in the housing market and considerable price changes. Moreover, the previously discussed accelerator effects explain the occurrence of cycles, even without speculation<sup>17</sup> or migrations and changes in demographic factors.

Figure 6. A simple model of the cycle



Once the market is put out of equilibrium, it replicates, and often deepens its cycles through a short-term rigid supply and flexible demand. The mechanism, presented in Figure 6, is as follows. A demand shock leads first to a price growth, as supply is fixed at  $S(t_1)$ . This in turn makes developers increase their production, but

<sup>17</sup> Various speculative motives should be distinguished. We may have to do with classical speculation involving an attempt to generate windfall profits. The investor buys housing today to sell it at a higher price tomorrow. Yet, speculation may also have a fundamental base and be rational. A prospective buyer may expect prices to increase in the future, thus not being able to buy it with available loan. In this situation buyers decide to purchase housing as soon as possible, thus exert an upward pressure on prices.

the result will be visible with a lag, and few years later the supply increases to  $S(t_2)$ . However, at some point the excess supply makes prices go down and the developers decrease their new production and the cycle continues. If the demand would be stable, the construction sector would slowly converge towards the equilibrium that lies somewhere between  $S(t_1)$  and  $S(t_2)$ . But the pro-cyclical behaviour of market participants like speculations and often also public factors (like economic and supervisory policy) make the demand shift and are significantly destabilizing factors. Therefore, the equilibrium will change over time and the market will only converge towards it. The cycle mechanism is determined by the shape of the demand and supply curves, in particular by the angle between them, which makes fluctuations more expansive or gradually dampened.

As the disequilibrium starts building up, the price growth is observed with a certain time lag, which is usually a quarter of a year. But before prices go up, developers notice that the number of households that ask for a dwelling increases strongly. Observations of the market, especially of the correlations between newly commenced projects, demand and prices show that demand growth alone is sufficient to trigger production growth.

A similar mechanism of nonlinear interactions, yet this time negatively affecting business conditions in the sector, will be observed amidst downward price rigidity that is commonly observed in this market. Should prices stiffen at a level ensuring that real estate developers generate decent financial results, they will embark on new investments and build housing on stock, waiting for better times to come. Due to a large margin they will be able to reduce the price and sell the supply surplus at a profitable price. Considerable possibilities of financing the unsold housing stock at high margins constitute factors favouring such practices. For example, if the rate of return on equity stands at around 20%, which is not an extraordinary result in this industry, real estate developers may finance with current housing sales a three-year stock of unsold housing and even more unfinished housing units (pre-sale construction contracts). However, in reality, amidst a relatively low price elasticity of demand at high prices, the possibility of price reductions and a profitable sale of the housing surplus are limited. The cumulating

unsold housing stock adds to the developer's risk<sup>18</sup>. In the subsequent period, price declines may be abrupt and construction may collapse. The supply elasticity may also change, modifying the size of construction in response to the price shock.

The analysis shows that a proper short- and medium-term analysis of the housing market requires a housing model that focuses on housing units (newly completed and those from the existing stock). In this perspective, the factors affecting the demand at time  $t$  concern the housing unit market, while the inflow of new capital (housing) takes place through the real estate development sector at time  $t+1$ . Similarly, the inflow of capital providing financing to final home buyers is captured in the demand curve. This model shows that even relatively minor changes in fundamental factors trigger demand shocks. Those, in turn, first generate oversupply and then trigger downward adjustments, which consequently leads to strong cycles. Additional disturbances in the market may be seen in the form of speculative behaviour as well as the impact of regulatory factors. Those additional factors affect the shape of the cycle, providing it with a stochastic character actually observed in the housing market.

In theory, housing cycles could be avoided should companies conduct market research and were able, in reliance thereon, to determine the equilibrium supply and synchronize their supply. Yet, basing on practical knowledge on the real estate

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<sup>18</sup> These considerations may be illustrated on the example of the Warsaw market, which is based on empirical observations, described in Part I of the Annual Report of the NBP (2012) and its previous editions. Let us assume that the annual absorption of the supply from the primary market at a price of PLN 7 000 per square meter is 13 000 housing units, and the absorption from the secondary market is of similar size. Price elasticity of demand is  $-0.5$ , and the costs of production, including land costs are PLN 4 000 per square meter. Lowering prices to production cost levels, thus lowering them by about 40%, real estate developers may expect a 20% increase in demand. This means a growth in demand for additional 2600 dwellings a year, as the remaining 2 600 will be sold in the secondary market. Even assuming a greater rigidity of prices in the secondary market and demand being shifted to the primary market, this means at most a demand growth for 5200 dwellings. If, due to the previous construction boom, the market sees its annual supply in real estate development housing double to reach 26 000 housing units, the price would have to fall by at least half, or below the cost of construction to clear the oversupply; with a threefold growth in annual production the price level that clears the market will be around PLN 2 300 per square meter, thus well below production costs. Rigid prices will result in tension accumulation and sharp price declines in the subsequent period, when additional, negative factors come to play. The NBP's studies on the Warsaw market demand show that it is quite rigid and may get flexible only at the level of PLN 2000-3000 per square meters, which is below the cost of production.

market this task may be considered as infeasible. The basic difficulty is a 2-4 years long time lag between the investment start and its effects, in which the equilibrium conditions change. Another problem is the fact that it is practically impossible to coordinate the production in a free and competitive market; what is more, such actions could be viewed as cartel practices.

The only way to smooth the housing market cycle is to smooth demand. This can be done either with prudential regulations that curb the loan availability or with fiscal policies which, through higher taxes or lower subsidies, make housing less affordable. Another stabilizing factor are housing policies which help to satisfy the need for housing. For example a well-functioning rental market will make households less willing to buy owner occupied housing, thus it will smooth demand shocks.

## 4. Conclusions

Cycles are a very complex feature of the residential real estate market. Although they are inevitable, a well-matched demand steering policy can have a smoothing effect. The investigation of housing market cycles must be based on the analysis of the number of housing units, as it is the mismatch between the number of desired and affordable housing units in the short term that boosts prices and, consequently triggers cycles.

In the housing market a multiplicative nature of price changes may be observed. It triggers severe shocks on the demand side, and consequently leads to an excessive supply. Those shocks, depending on the elasticity of supply and demand, can either fade away or explode.

Our analysis of the impact of interest rates on demand shocks shows that macroeconomic housing models must rely on sound microeconomic foundations. Minor changes in interest rates, which at the macroeconomic level appear insignificant, on the account of their strong influence at the microeconomic level, translate into housing market shocks being felt throughout the entire economy.

To sum up, we can say that the main difference between the analysis in the short and in the long term is the importance of housing construction and the percentage of housing stock on sale, participating in the adjustment process. In the short term, the share of the housing stock on sale is small, and production growth is determined by marginal costs. In the long term, housing stock adjustments are becoming increasingly important and the supply of new housing stock is determined by long-term average costs.

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